THESIS

USING MOVEMENT WITH YEAR 8 SPECIAL NEEDS STUDENTS TO IMPROVE STUDENTS’ LEARNING IN MATHEMATICS. AN ACTION RESEARCH PROJECT.

Submitted by
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A thesis submitted in partial fulfilment of the requirements of the degree of

Master of Education

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Submitted: October 2016
DECLARATION OF AUTHENTICITY

This thesis is my own composition and is the result of my own research and work.

It contains no material that has been published elsewhere or taken in whole or part from a thesis by which I have qualified for or been awarded another degree.

No other person’s work has been used without acknowledgement in the main text of this thesis.

All research procedures reported in this thesis have been given the approval of the Education Research Ethics Committee of Morling College Ltd.

Signed: Jo-Anne Barn

Dated: 31st October 2016
PREFACE

I wish to acknowledge our mighty God, his love and ever presence.

I also want to take this opportunity to thank a number of people for their assistance in this venture.

To my mum who introduced me to God and taught me to believe in my ability to achieve and overcome despite how I felt about myself. Her belief in me sometimes out weighted anything I had, thank you.

To my dad for his love and encouragement particularly this year, thank you.

To my husband, my love, my soft place to fall, for picking me back up each time I needed it, for your unquestionable belief in my ability that greatly outweighed my own, thank you.

To my children, for their love and belief in me, thank you.

To my lecturer, Dr Pamela Harvey, for the support, guidance and patient redirection, thank you.

To my colleague, dear friend and sister in the Lord, Mandy, what a crazy ride we have been on, to have a companion on this journey has deepened the learning experience and kept me sane, thank you.

And to the generation who will follow, my children and step children, you will go on to do even more than we could dream of, believe in the journey, connect deeply to God and live it fully.
ABSTRACT

Traditional teaching methods consist of the teacher delivering a lesson while the students sit passively absorbing this new knowledge. However, the growth in the area of neuroscience and studies on the brain are increasingly showing a positive co-relation between movement and cognitive function. There is also much research on the power of the mind in overcoming difficulty. This research demonstrates the incredible features of the human body that has been created by the Almighty God and considers how this growth in neuroscience may be used in current pedagogy particularly in the highly specialized area of special needs education.

This area of neuroscience informs the current study that investigates how movement as well as positive affirmations may be used with a special needs year 8 class to increase student focus, engagement, and greater independence in order to improve learning outcomes. This study used an action research design consisting of two cycles each of two weeks. In the first cycle, students participated in aerobic exercise immediately prior to a mathematics lesson being taught. In the second cycle the students participated in aerobic exercise combined with positive affirmations being called out by students. The positive affirmations were statements of belief in ones’ ability in the subject area of Mathematics. Analysis of the results demonstrated that for this special needs Year 8 class there was benefit in participating in aerobic exercise combined with positive affirmations with greater student focus, engagement, independence and reduced time off task in the Mathematics class.
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CHAPTER ONE: INTRODUCTION

1.1 Background to the Study

The age-old approach to teaching was one based on teacher delivery while the students sat passively to receive the new knowledge. Current evidence suggests that movement is vital to student wellbeing and overall learning (Jensen, 2005). Further, that students should be treated as whole people where the mind and body are connected (Hannaford, 2005; Jensen, 2005, p 15; Medina, 2014; Ratey & Hagerman, 2008). In my experience often the body or the physical needs of the student are not accommodated within the classroom context. As a special needs teacher I have found that movement in the classroom can be very disruptive and can interfere with the learning process.

Special education, the education of students with conditions such those on the autism spectrum, emotional and behavioural issues, is a field that is unique and challenging. For the Christian teacher each student is unique and made in the image of God (Gen 1:26,27) although that image was marred by the Fall (Gen 3). Many standard teaching practices need to be rethought and modified. The Christian teacher often requires special grace and patience in showing these students God’s love in action especially as students with special needs can be difficult to settle in the classroom environment. All students in my Year 8 class have a diagnosed condition, there are a significant proportion who present with co-morbidities. Co-morbidities are the existence of more than one diagnosis; this can result in one diagnosis being dominant or some combination. The implication of this is that two students may present with the same diagnosis with co-morbidities, yet the dominance may vary. Therefore, no two students respond behaviorally or academically in the same manner. My students have all experienced difficulty in mainstream education, they arrive often broken and
believing themselves to be unable to learn. This is most significant during mathematics where many students have performed poorly in their previous school. As a Christian teacher I want to provide my students with effective teaching practices that provide them with confidence in the abilities that God has given them so that they realise that they are of value to God and others.

I limit student movement in the classroom because if students are permitted to move about the room invariably they invade each other’s space and disruption to learning occurs as negative behaviours increase. Therefore, staff bring materials to students. However, latest research indicates that students require movement to increase brain function (Jensen, 2005; Medina, 2014). There are many ideas and suggestions for incorporating movement into the classroom, such as brain gym and aerobic exercise combined with positive affirmations.

1.2 Purpose of this Study

The purpose of this study is to determine if there is a positive correlation between aerobic exercise, both with and without voiced affirmations, on students achieving the learning outcomes in Mathematics. The markers that will be examined are greater levels of student independence, improved focus and higher levels of student engagement in lessons.
1.3 Statement of the problem and Research Question

Students with special needs have a unique presentation of issues that may result in them experiencing difficulty in accessing educational outcomes. Teaching special needs students can be challenging, particularly settling them to learn. Allowing them to move around the classroom may result in an increase in negative behaviours. Current research leans heavily towards increasing movement for all students within the classroom context in order to more effectively teach the individual. Therefore, how can movement be incorporated into a special needs classroom to improve learning outcomes?

Research question

How effective is using movement prior to mathematics lessons, with Year 8, special needs students in improving learning outcomes through developing greater independence; improved focus and engagement in the lesson?

1.4 Benefits of the Study

The research study should be of direct benefit to the students involved in the study as it is expected that they will demonstrate improved levels of student focus, engagement and increased levels of independence within the lessons. This improvement in student outcomes should also have a direct benefit for the teacher/researcher in reducing the time in encouraging positive student behaviour and increasing the time for additional teaching and learning. An added benefit of this study is an improvement of fitness levels of the students in the study. Aerobic exercise three times per week for 20 minutes will assist with improving
resting heart rates of all participants which in some way could also assist in helping to address
the increase in obesity and sedentary lifestyles in young people.

It is expected that teachers of other classes within the same school could also benefit from
the results of the research and be encouraged to implement such an exercise program within
their classes. In addition, the benefits of the study could extend to other special needs
teachers and schools in encouraging them to implement a similar exercise regime before
class. As such there is no reason why this could not be adopted by teachers in all schools.

1.4 Outline of the Thesis

This chapter has introduced the study entitled: Using movement with Year 8 special needs
students to improve students’ learning in mathematics. It has also provided a background
and a purpose of the study, included details of the research problem and research question
and the benefits of the study. The next chapter presents the literature review of the
relevant literature related to the study. Chapter Three gives details of the research design
and methodology. Chapter Four outlines the results of the study and Chapter Five provides
a discussion of the results. Chapter Six, the final chapter includes a conclusion and
recommendations arising from the study.
CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This literature review examines the literature firstly related to using movement to assist students learning. The basis of which is an increase in research on the brain, derived from neuroscience. The review then focuses on two specific types of movement that can benefit students learning. These include the brain gym program, and aerobic exercise. Each are examined for benefits relating to young people particularly those with special needs and the flow on effects within the academic setting.

2.2 Neuroscience

There is a growing body of research that suggests that movement is beneficial to student learning. Indeed, many studies have begun into the impact of movement on the human brain. Yet, formal study of the brain is relatively new. Harvard Medical School was the first to offer an independent neuroscience department in 1966 ("Harvard Medical School", 2016). Neuroscience, as described by the University of New South Wales, is the study of the neural system, which involves the nervous system and the brain. This is considered to be one of the last great frontiers of investigation and study (Ihnen, 2009, p 4; Suzuki & Fitzpatrick, 2015, p 152; UNSW medical sciences, 2015).

As a special needs teacher these are of interest as many diagnosed conditions impact the human brain and change the way an individual learns and retains new information. The diagnosed conditions that are of interest in relation to this study include Attention Deficit Hyperactive Disorder (ADHD), Post Traumatic Stress Disorder (PTSD), anxiety and depression as well as the Autism Spectrum of Disorders (ASD). An example with the impact on the
individual who is diagnosed with PTSD. This occurs when an individual experiences extreme trauma, this cannot be healed by the body and it results in long lasting changes in the human brain (Crandall & Howard, 2007, p 1). It can impact the hypothalamus which is deep within the brain and responsible for memory. Likewise, the other diagnosed conditions all impact on the human brain and change the way that the brain responds. Accessing studies into the benefits of movement for students with Attention Deficit Hyperactive Disorder (ADHD) is readily available, however little research exists into the benefits for other diagnosed conditions.

2.3 Benefits of Movement

2.3.1 The Benefits of Movement in General:

Movement has been cited as beneficial to student engagement and motivation (Blakemore & Frith, 2015, Jensen, 2005). When students have greater levels of engagement and are more motivated towards their learning, then student learning will improve. Movement also contributes to an increase oxygen flow to the brain, which is known to have benefits for student learning (Conyers & Wilson, 2013; Jensen, 2005). Further, movement has been shown to assist in a reduction of negative student behaviours (Conyers & Wilson, 2013; Fiore, 2014; Jensen, 2005). This is particularly the case for students diagnosed with Attention Deficit Hyperactive Disorder (ADHD), as these students find sitting for long periods of time challenging. Therefore, if movement is able to be used in conjunction with teaching practices, it has been shown to improve student learning.
2.3.2 The Benefits of Movement Derived from Formal Studies on the Brain:

Initial studies, in the area of neuroscience, focused on the brains of animals, this has now moved onto the brains of humans. Bennet, Diamond and Rosenzweig performed a classic piece of research in 1972. Crane (2016) reports upon this research which was titled *Brain Changes in Response to Experience* and describes how it was performed on male rats who were randomly chosen. They were then placed in three different environments, a controlled setting with three other rats, yet no toys, an impoverished setting with neither toys or other rats, and the enriched environment with other rats and toys. The rats spend from 30 to 60 days in their environment before being euthanized and their brains studied. The findings showed that the rats that were in the enriched environments had larger brains with greater connections than did the rats of the control or the impoverished conditions. Initially, it was believed that the rats from the enriched environments had more fully developed brains due to the extra stimulation, it has subsequently been questioned if it was in fact stimulation or exercise. (Suzuki & Fitzpatrick, 2015, p 17, 123).

For many years it has been believed that the brain once developed was static and could not continue to grow and change. It was also believed that once damaged the brain could not recover, therefore doctors and health care professionals, trained during the 80s were taught to encourage their patients to compensate for any issue as recovery was thought to be impossible (Leaf, 2013, pp.19-20). This occurred after Cajal stated, in 1930 that nerve pathways once developed became fixed and static (Leaf, 2013, p61). The research by Bennet, Diamond and Rosenzweig (1972) was one of the first that would go on to challenge this notion of the brain being fixed once it had reached optimal growth. This study demonstrated the concept of plasticity, or the idea of the brain being able to respond to its environment and
change itself (Arrowsmith-Young, 2012, p 9; Bennett, Diamond & Rosenzweig, 1972). It was significant as it provided validation for the concept of plasticity and growing the brain, actually making it larger, through stimulation and exercise. Yet, this was not understood at the time. It is now widely understood and accepted that the brain is considered plastic and able to change (Ihnen, 2009, p1).

Research shows that movement can enhance brain connections and affect aspects of learning that include recall, function, improved mood and increase overall learning (Blakemore & Frith, 2015, p 134; Van, 2012, p 18). Ratey, a well-known author and world leader in brain-fitness connection, deduced that exercise is responsible for the production of a product that he refers to as “Miracle-Gro or brain fertilizer” (Ratey & Hagerman, 2008). This is scientifically known as brain-derived neurotrophic factor or BDNF. BDNF is responsible for keeping existing neurons young and healthy. The hippocampus, which is deep within the brain, is part of the brain responsible for memory and learning. Therefore, if exercise increases levels of BDNF that are located in the learning centre of the brain it increases the ability for learning to occur immediately after exercising (Dishman et.al, 2006, p 347; Medina, 2014, p 31; Suzuki & Fitzpatrick, 2015, p 133).

As a result of the growth in knowledge of the brain, there are a vast number of studies that have been conducted in very recent years on a variety of different aspects of aerobic fitness, obesity and its relationship to brain function. The plethora of studies focus on different aspects of the brain, as yet as the brain is so complex more research is still required.
2.4: Types of Movement

2.4.1 Brain Gym

Brain gym is a series of 26 exercises designed to “turn on” the brain (Brain Gym International, 2015; Dennison & Dennison, 1994). These exercises focus on a variety of different ways to cross the arms and legs over the middle of the body and are intended to assist the brain in creating greater connections between the left and right hemispheres. This program has been used both in the United Kingdom and Australia in classrooms (Goldacre, 2006; Nan, 2013). Upon investigation it is apparent that brain gym has a divided following. Hannaford (2005), an educator and author implemented brain gym exercises in 1986 when she began to work with special education students. She reports that results were startling as student began to succeed academically as well as becoming more able to operate independently (Hannaford, 2005, p 122). In her book *Smart Moves* she shares a story that came out of Russia in 1989 (Hannaford, 2005, p 127). A doctor had been working with children who had been severely traumatised as the result of a train explosion. The doctor was using a variety of therapeutic approaches including art therapy to no avail. Several weeks after introducing brain gym the children began to show signs of improvement, the colours in their painting brightened and the composition changed from charred remains to bright flowers. The doctor believed the children to be healing emotionally. The doctor attributed the changes in the children to their involvement with the brain gym program (Hannaford, 2005, p 127).

The greatest area of criticism that has been leveled at the brain gym program has come from the lack of scientific research (Goldacre, 2006). As a result, a number of studies have emerged (Beam, Mostert, Spaulding, 2010; Gibbs, 2007). As yet they have not presented strong findings as to the benefits of incorporating brain gym exercises into the classroom. This coupled with the negative press that brain gym has received both in Australia and in the
United Kingdom led me to believe that this is not the approach to explore at this time (Goldacre, 2006; Nan, 2013).

2.4.2 Aerobic Exercise and Formal Studies

Aerobic exercise is exercise that stimulates the heart and lungs and as a result it improves the body’s use of oxygen (MedicineNet, 1996). Aerobic exercise includes running, swimming, rowing, cycling and activities that are fast paced like star jumps. Weight bearing exercise by contrast is exercise that involves the strengthening of various muscles, predominantly through the use of weights or resistance. It is commonly known that an individual who has a high level of aerobic exercise will have a high fitness level.

Suzuki states that there have been studies focused on the elderly in relation to brain changes and exercise (Suzuki & Fitzpatrick, 2015, p 133). The process of ageing causes the hippocampus to shrink; this can lead to age related diseases such as dementia. A study conducted in 2011 sought to determine if exercise could increase the size of the hippocampus and thereby increase memory. One hundred and twenty older adults were randomly chosen and placed in one of two groups. The first engaged in aerobic exercise three times per week, for a period of one hour, totaling three hours’ aerobic exercise for the week. The second group engaged in stretching exercises. Participants had brain scans taken before and after participation. At the conclusion of the study those who had participated in the aerobic exercise in general had growth in the hippocampus of 2% (Erickson et.al, 2011).

There have been an increasing number of studies conducted throughout the world, on younger healthier people in order to determine the relationship between exercise and brain function (Buck, Castelli, Erwin & Hillman, 2005; Caputo, Eveland- Seyers, Farley, Fuller & Morgan, 2009; Dwyer, T., Sallis, J.F., Blizzard, R.L., Dean, K., 2001; Mahar et al., 2006).

Dwyer is an Australian researcher who has conducted multiple studies into this relationship.
His studies gathered data, from 1984 on, prior to the focus on neuroscience. He has measured heart rate and fitness levels of young people and has determined that not only does exercise boost academic performance, it also serves to have a calming effect on the student allowing them to sit for longer periods and focus (Jensen, 2005; Dwyer, Sallis, Blizzard, Dean, 2001; Mahar et al., 2006).

In South Africa a study was conducted on children aged between nine and 12 years to examine the relationship between physical fitness and academic performance (Du Toit, Pienaar & Truter, 2011). This study concluded that there in a positive correlation between physical fitness and academic performance. Similar research has been conducted in America, Australia, Korea with a parallel association between the two variables (Buck, Castelli, Erwin & Hillman, 2007; Caputo, Eveland-Seyers, Farley, Fuller & Morgan, 2009; Dwyer, Sallis, Blizzard, Dean, 2001; Ellemberg and St-Louis-Desèhenes, 2010; Grieco, Jowers & Bartholemew, 2009; Mahar et al., 2006).

In 2011 a study was conducted on sedentary, obese children aged between seven and 11 years in the state of Georgia, USA (Davis, et.al, 2011). In this study 171 children were placed in random groupings and involved in various levels of aerobic exercise. A control group participated in no exercise, the next group participated in 20 minutes of exercise per day and the final group participated in 40 minutes of exercise per day. The children were given pre and post study testing for cognition and achievement using a standardized psychological assessment, as well as Magnetic Resonance Imaging (MRI) on the brain. The results indicated that those who participated in the greatest amount of exercise performed better, their performance in mathematics was noted as having improved. The area of the brain that was tested was the prefrontal cortex; this area of the brain is connected to executive
function. Executive function is an area of the brain that is associated with organisation, order and focus. It assists with self-regulation, working memory and problem solving (Barkley, n.d.). Therefore, this study could have significant benefits for students who are diagnosed with a condition that relates to the frontal lobe of the brain such as ADHD or even students on the autism spectrum (Autism Speaks, 2016). This study recommended that educators include vigorous physical activity within the school context, to assist executive function and children’s learning.

Medina (2104) is a developmental molecular biologist who shares the view that aerobic exercise benefits brain function. He has spent many years researching and lecturing on how the brain works. He has actively engaged in research on the genes of human brain development. Medina’s book titled *Brain Rules: 12 principles for surviving and thriving at work, home and school*, also devotes a chapter to exercise, and the how exercise improves cognitive function (2014). He is specific in that the exercise must be aerobic exercise, not weight bearing exercise for it to impact the brain. He suggests that an individual should participate in exercise two to three times per week in order to improve brain function.

### 2.4.3 Aerobic Exercise and Informal Studies

There are also informal studies made in special education institutions where aerobic exercise has been employed with beneficial results. Students with ADHD have become settled and able to focus on academic work. They have noted that academic tasks are more easily achieved after exercise (Active living research, 2013; CBC National News, 2011; Edutopia, 2015; Gordon, 2011; Ratey & Hagerman, 2008). One such program was observed by Ratey in Naperville, U.S.A. Ratey is a well-known author and world leader in brain-fitness connection. He holds that exercise is essential to activate the brains of students. While investigating this
phenomenon in 2003, Ratey became aware of a school in Naperville in the U.S.A that was involved in daily aerobic exercise and the educational benefits that were being experienced. Students were involved in daily aerobic exercise increasing their heart rates to 80% of capacity for at least 45 minutes per day. These students were shown to be performing in the top sectors in national and international testing. Added to this was the fact that obesity rates were in the lowest for the country as well as a reduction in behavioural issues. (Ratey & Hagerman, 2008). Ratey visited this school and learnt of their program. As a result of witnessing this program Ratey began to deduce the connection between exercise and increased brain function (2008).

Another incidence of this approach occurred in Saskatoon, Canada. A special education teacher adopted the Naperville model in 2008. The teacher, Allison Cameron, modified the Naperville model to allow her students to exercise in the classroom (Gordon, 2011). The special education program that she was involved in was created for students who had no other schooling options left to them. They generally had a diagnosis of ADHD and had all experienced extreme difficulties in the education system prior to attending this program. At the back of the classroom were a number of treadmills and exercise bikes. Students were expected to exercise everyday raising their heart rate while monitoring it to ensure it stayed above 80%. Within four months of embarking upon this new program Cameron noticed radical changes with her students. The changes ranged from behavioural modifications whereby students with conditions such as ADHD were finding it easier to concentrate and focus to complete academic tasks. Cameron also noted that students’ scores on basic testing had improved noticeably. This was not a formal study, rather a real life experiment (CBC National News, 2011).
2.4.4 Aerobic Exercise with Positive Affirmations

The power of the mind is well known. Indeed, sports people have been accessing the power of positive thinking in order to assist them in achieving their goals for many years. There are many studies into the power of positive thinking on sports people. Sports psychologists like those associated with the British Psychologist Society hold not only is positive self talk important, but negative self talk can be detrimental to sporting performance and goal achievement (British Psychological Society, 2012).

Bandura (1993), a psychologist discussed the link between self belief and achievement of goals and challenges. If an individual has a high level of self belief they will generally set higher goals believing that they can attain them. Conversely, if they have little self belief they will most naturally believe that they will fail in a goal area. Bandura cites a study by Collins (1982) where students studying mathematics were observed. Those who had greater self belief proved to be more resilient and willing to attempt to problem solve when a mathematical problem became ‘too hard’, whereas those who had little self belief gave up more easily and quickly.

Bernard (2011) conducted research into college students and their levels of self talk related to their success within their academic studies. In all 114 students participated in this study, aged between 18 and 48 years. They completed a questionnaire relating positive self talk to personal goals. The results indicated positive correlation between positive self talk and readily achieving goals.

Intentional exercise as described by Suzuki, is exercise linked to positive affirmations (2015, p 105), which include the participants calling out while exercising statements such as “I am getting stronger” and “I can do this”. Suzuki (2015) conducted research on a university class. This involved her students participating in 60 minutes of aerobic exercise combined with
positive affirmations. Results showed greater memory retention in the students who participated in the compared to the control group (Suzuki & Fitzpatrick, 2015, p147).

Suzuki then investigated the benefits of aerobic exercise with positive affirmations for victims of traumatic brain injury (Ashman, Lee, Shang & Suzuki, 2014). The participants in this study were aged from 20 to 60 years. All had sustained traumatic brain injury. They engaged in an eight-week program, exercising twice per week (Suzuki & Fitzpatrick, 2015, p 148). Again this was intentional exercise, exercise combining positive affirmations. The group was tested against a control group; both before and after the exercise program was conducted. The testing focused on memory and attention. The results showed memory and attention remained unchanged (Suzuki & Fitzpatrick, 2015, p 151). However, there were many other changed that were noted and documented. The exercise group showed significant improvement in mood and quality of life measures (Suzuki & Fitzpatrick, 2015, p 151). Some participants were unable to coordinate their bodies at the beginning of the class, or were unable to tolerate the loud music, yet at the conclusion they displayed coordination and enjoyment of the music and the exercises.

2.5 Conclusion

This literature review has examined the growing body of evidence that suggests that movement is beneficial to student learning. It is apparent that movement increases both student engagement and the brains ability to focus and retain information. Two types of movement were investigated, the brain gym program and aerobic exercise. There is a growing body of research both formally and informally conducted that is continuing to show a positive correlation between aerobic exercise and increased brain function (Buck, Castelli, Erwin &
Hillman, 2007; Caputo, Eveland- Seyers, Farley, Fuller & Morgan, 2009; Dwyer, Sallis, Blizzard, Dean, 2001; Ratey & Hagerman, 2008). Studies cited have shown that aerobic exercise can assist with increased brain function. The implications that exist for the classroom becoming apparent. As children are increasingly living sedentary lifestyles, it can no longer be assumed that children will be active outside of school hours (Davis, et.al, 2011). Therefore, teachers should increasingly seek to teach the whole person and I would suggest incorporate aerobic exercise. This has ramifications for teachers of special needs students. As aerobic exercise is combined with positive affirmations the whole person is more fully engaged and the benefits for physically impaired students appears to be particularly helpful. Such studies as Ashman, Lee, Shang & Suzuki, (2014) have demonstrated that use of aerobic exercise with positive affirmations has enabled physically impaired individuals regain function and quality of life improved for many.
CHAPTER THREE: METHODOLOGY

3.1 Research design:

The research design used qualitative research as the study is focused on understanding and describing what is currently occurring in the classroom as opposed to attempting to predict or control as occurs through quantitative research (MacDonald, 2012, p 34). Action research was chosen as it is a suitable approach for the study as it focuses on the collection of data in order for further action to be taken. It is reflective in nature and seeks to bring about an improvement in situations (Baum, MacDougall, Smith, 2006, MacDonald, 2012).

Action Research allowed the researcher to introduce a form of exercise and affirmation with her own students.

Action research is cyclical and each cycle is comprised of four stages, planning, acting, observing and reflecting. The planning stage is the identification of the issue that requires change, as well as research into how others are solving similar issues. A plan then to enact change is developed. During the acting phase the plan is implemented and data is collected and recorded. The next phase is the observation phase where the analysis, write up and sharing of the findings occur. The final phase of reflecting involves an evaluation of how effective the implementation of the first cycle of the process was, a decision to implement the findings of the first cycle including any changes that are required for the second cycle (DET, 2010, p 3). The research then continues in a second cycle implementing the findings and changes identified from the first cycle. The research can then continue in this cyclical manner as deemed necessary. In this study there were two cycles of two weeks each. More detail in relation to these cycles is outlined below.
Cycle One:

Planning stage: Involved assessing each student’s fitness level, this involved having the students run laps while monitoring their heart rates. After the students ran for five minutes, the teacher/researcher spoke with them. All students were able to hold a brief conversation, the students were taught that this was one of the signs, along with their heart rate, that they were exercising at a healthy level. The students learnt that their heart rates were in the vicinity of 150 beats per minute.

Aerobic exercise was then introduced three mornings per week before the Mathematics lesson. The aerobic exercise comprised of running laps initially to increase heart rates, then either playing soccer or basketball. The plan was for students to participate in 20 minutes of aerobic exercise, thereby increasing their heart rates for 20 minutes.
**Action stage:** Teacher implemented the aerobic exercise and noted any changes in the lesson related to student engagement, focus and behaviours associated with learning in mathematics.

**Observing stage:** Data was gathered from instruments which include student surveys, student interviews and teacher observations recorded in a journal. This data was then collated and analysed.

**Reflecting stage:** An evaluation of the aerobic exercises and the impact on student learning informed any changes or improvements that were made prior to moving into Cycle Two.

**Cycle Two:**

**Planning stage:** Involved introducing positive affirmations while participating in aerobic exercise for 20 minutes to maintain heart rates. The affirmations included the following two statements, “I am good at maths” and “I can do this.” In addition, any changes that were identified from Cycle One were included.

**Action Stage:** Teacher implemented aerobics with positive affirmations and noted any changes in student engagement, focus and behaviours associated with learning.

**Observing stage:** Data was gathered from the instruments which included student surveys, student interviews, as well as teacher observations recorded in the teacher journal. Data was then analysed and then compared across both cycles.

**Reflecting stage:** An evaluation took place of the aerobic exercises combined with positive affirmations and the impact on student learning.
3.2 Research Participants

The population for this research were students in a special needs school in Newcastle, N.S.W. The sample for the study was taken from the year 8 class for 2016 of approximately 12 students. These students have a variety of diagnosed conditions. These diagnoses range from students on the autism spectrum to students with Attention Deficit Hyperactivity Disorder and those with co-morbidities. The sample included 10 male students and two female students.

Four (three male and one female) of the 12 students were invited to be interviewed. These four students were chosen based firstly upon their willingness to take part in the study and secondly upon their diagnosis and presenting traits, so providing a cross section of the sample of 12 students.

3.3 Research instruments:

Action research is a form of qualitative research. Qualitative research requires multiple types of data collection that is cross checked for common themes (Creswell, 2014). This also allows a holistic picture of what is occurring for the participants within their setting to be created. Creswell (2014) informs that interviewing, observation and conducting surveys are some of the methods of data collection. Also that data is generally collected by the researcher themselves.

3.3.1 Teacher observations, (Appendix 1) were recorded in a journal. The teacher made observations on all students in the class. These observations included student posture, focus, engagement, and behaviour, factors which help teachers in monitoring students
learning (Appleton, Christenson, & Furlong, 2008). The indicators for each of these factors include the following five:

- Changes in student focus, students following lessons, raising their hands to answer questions and completing set tasks.
- Changes in students sitting posture, students sitting at their desks with feet on the floor and heads in the upright position.
- Changes in academic progress, this will be demonstrated by indicators like: students completing more mathematics problems than they previously had. Or getting more correct than they previously had. It may also be shown by students taking less time to understand a new concept.
- Changes in student behaviours, this will relate to the individual student, if for example one student has difficulty with impulse control, it is hoped that a positive change whereby he controls his impulses to a greater degree, and does not impact those around him as greatly.
- Changes in student level of independence, for example, student being able to problem solve small tasks such as, knowing when to open their workbook, knowing what colour pen to use.

3.3.2 Student surveys (whole class). Three student surveys were developed to gather data on. The purpose of a survey according to Creswell (2014) is to obtain information for the chosen population in a way that will allow this information to be generalised and inferences made regarding a specific issue or factor. The use of the survey in this study was to obtain information from the students to determine the students’ fitness, their learning ability in
mathematics and how they felt about studying mathematics. This question was repeated over time to determine if the class experienced a shift of any kind. Thus, the collection of data was longitudinal (Creswell, 2014). The first survey (Appendix 2a) comprised of two open-ended questions for students to indicate what type of exercise and how much they were involved in per week. It also contained 10 closed questions related to their fitness with a four point Likert scale from strongly agree to strongly disagree. This survey was conducted prior to the commencement of cycle one of the study.

The second survey (Appendix 2b) was comprised of seven closed questions that related to the students' feeling on mathematics, their ability to concentrate in mathematics and their participation in the aerobic exercises with a four point Likert scale from strongly agree to strongly disagree. This survey was conducted at the end of cycle one.

The third survey (Appendix 2c) was comprised of 10 closed questions related to the students' feeling on mathematics, their ability to concentrate in mathematics and their participation in the affirmations with aerobic exercise with a four point Likert scale from strongly agree to strongly disagree. This survey took place after cycle two. The survey questions in all three surveys were similar so that the results could be compared after each cycle. The questions in the final survey also included asking the students to rate the impact of the aerobic exercise and positive affirmations upon their focus, concentration and overall learning.

3.3.3 Student interviews (Appendix 3) There were two sets of interview questions which were included to follow up in more depth the data collected from the surveys. The first set of interview questions was administered at the end of Cycle One and comprised of five open ended questions related to student learning style, ability to focus during mathematics and more detailed responses to the aerobic exercise and its impact on student learning. The interview following Cycle Two was comprised of six open ended questions which were similar
questions to the first interview but also included students’ comments on the positive affirmations. Students were interviewed by the researcher, in the hallway outside the classroom, during quiet reading time for the rest of the class. They were conducted face to face, with the researcher taking notes as the student answered and took approximately 15 minutes per student.

### 3.4 Research Procedure Timeline

<table>
<thead>
<tr>
<th>Term 2: week 5, 2016</th>
<th>• Consent form for parents caregivers to sign, including medical clearance for students to participate.</th>
</tr>
</thead>
</table>
| Term 2: week 7, 2016 | • Introduced students to aerobic activities with positive affirmations, run over the course of the week, this will include a familiarization with the heart rate monitors and the overall purpose of the study.  
  • Students completed pre-exercise survey.  
  • Interview with individual students prior to exercise. |
| Term 2: week 8 Monday, 2016 | • **Cycle one:** students participated in exercise. This occurred for 2 weeks, 3 mornings per week for 20 minutes.  
  • Mathematics lessons immediately after exercise was completed. |
| Term 2: week 9 Friday, 2016 | • Observations  
  • Students were interviewed  
  • Students were surveyed |
| Term 3: week 1, Monday, 2016 | • **Cycle two:** Introduction of basketball for the entire group, positive affirmations introduced. |
| Term 3: week 2, Friday, 2016 | • Observations  
  • Students were interviewed  
  • Students were surveyed |
| Term 3: week 3, 2016 | • Write up of results  
  • Write up of thesis |
| Term 4: week 3, 2016 | • Submit thesis |
3.5 Data collection and analysis

The results from each of the surveys was recorded on a spreadsheet and analyzed by comparing the results of each of the three student surveys. The answers to the interview questions were also recorded on a spreadsheet and compared; in addition, they were also compared with the survey results after Cycle One and then after Cycle Two. Common themes were identified from the students’ answers to the interview questions as well as any differences between students’ responses. These responses were then compared with the teacher observations to ascertain students’ perceptions of the effect of the exercise on the students’ engagement in class.

3.6 Validity and Reliability

The choice of three instruments within the study allowed for a triangulation of data and thus its reliability (Creswell, 2014, p201). Cross checking of data between the teacher observations, the three surveys and the interviews allowed the researcher to observe responses to the same phenomenon from different perspectives ensuring validity of the data.

3.7 Research Ethics

The research was approved by the Morling College Ethics Committee. Additionally, the parents and carers of the students provided written consent for the minors in their care to participate in this study. The researcher was the class teacher and as such, made it explicitly clear that students were free to participate or withdraw as they chose. This aspect was
overseen by the principal of the school where the research took place, and was a requirement of the school in order for the study to be conducted in the school.

This chapter has provided the details of the action research methodology used in the study.

The next chapter will present the results of the study.
CHAPTER FOUR – RESULTS AND ANALYSIS

4.1 Introduction

This chapter presents the results and analysis of the responses to the survey questions and interviews with Year 8 students to ascertain if using movement with Year 8 special needs students improves students learning in mathematics. The research question that guided this study is: “How effective is using movement prior to mathematics lessons, with Year 8, special needs students in improving learning outcomes through developing greater independence; improved focus and engagement in the lesson?”

This Classroom Action Research involved two cycles of two weeks each. The sample was the Year 8 class of 12 students, ten males and two females, and in Cycle Two, an additional female student joined the class but not the study. However, she was absent when the survey was conducted so did not influence those results. Prior to beginning Cycle One, Survey One (Appendix 2a) was conducted with the 12 students. The survey related to the frequency and type of exercise, as well as student perceptions of fitness and enjoyment of mathematics classes. Table 4.1 and Table 4.2 record the results of this Survey.
Table 4-1- Results of Survey One-Part A & B

<table>
<thead>
<tr>
<th>Part (A) No of minutes of walking per day</th>
<th>No of student responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Over 60 mins</td>
<td>4 (33%)</td>
</tr>
<tr>
<td>40 – 50 mins</td>
<td>3 (25%)</td>
</tr>
<tr>
<td>30 – 40 mins</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>20 – 30 mins</td>
<td>2 (17%)</td>
</tr>
<tr>
<td>Less than 20 mins</td>
<td>3 (25%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part (B) Other types of exercise students engage in</th>
<th>No of student responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swimming</td>
<td>6 (50%)</td>
</tr>
<tr>
<td>Aerobics</td>
<td>1 (8%)</td>
</tr>
<tr>
<td>Soccer</td>
<td>6 (50%)</td>
</tr>
<tr>
<td>Football</td>
<td>6 (50%)</td>
</tr>
<tr>
<td>Running</td>
<td>6 (50%)</td>
</tr>
<tr>
<td>Netball</td>
<td>1 (8%)</td>
</tr>
<tr>
<td>Basketball</td>
<td>4 (33%)</td>
</tr>
<tr>
<td>Dancing</td>
<td>1 (8%)</td>
</tr>
<tr>
<td>Other: e.g. weights, reffing, skateboarding, motor sports, cycling, golf, hand ball</td>
<td>9 (75%)</td>
</tr>
</tbody>
</table>

The results of the Survey as recorded in Table 4.1 showed that 33% of students walked at least 60 minutes per day with over half of the students (58%) walking over 40 minutes per day. However, 25% of the students indicated that they walked less than 20 minutes per day. The most popular exercises that the students indicated they engaged in were swimming, soccer, football and running, with 50% of them involved in at least one of these types of exercise.
Table 4.2 Results of Survey One- Part C

<table>
<thead>
<tr>
<th>Question</th>
<th>Strongly agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I take part in some form of physical exercise out of school at least twice a week</td>
<td>4 (33%)</td>
<td>5 (42%)</td>
<td>1 (8%)</td>
<td>2 (17%)</td>
</tr>
<tr>
<td>2. I am fit</td>
<td>2 (17%)</td>
<td>5 (42%)</td>
<td>1 (8%)</td>
<td>4 (33%)</td>
</tr>
<tr>
<td>3. In my spare time at home I like to be physically active:</td>
<td>3 (25%)</td>
<td>4 (33%)</td>
<td>4 (33%)</td>
<td>1 (8%)</td>
</tr>
<tr>
<td>4. I find it hard to sit still in class for longer than 10 minutes</td>
<td>4 (34%)</td>
<td>6 (50%)</td>
<td>1 (8%)</td>
<td>1 (8%)</td>
</tr>
<tr>
<td>5. In my spare time at home I spend most of my time watching TV or in front of the computer or reading?</td>
<td>2 (17%)</td>
<td>6 (50%)</td>
<td>3 (25%)</td>
<td>1 (8%)</td>
</tr>
<tr>
<td>6. I like maths</td>
<td>3 (24%)</td>
<td>2 (17%)</td>
<td>5 (42%)</td>
<td>2 (17%)</td>
</tr>
<tr>
<td>7. I find maths easy to understand when my teacher shows me something new</td>
<td>2 (17%)</td>
<td>6 (50%)</td>
<td>4 (33%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>8. I find it easy to focus and learn during maths lessons</td>
<td>1 (8%)</td>
<td>3 (25%)</td>
<td>8 (67%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>9. I get good marks in maths</td>
<td>2 (16%)</td>
<td>5 (42%)</td>
<td>5 (42%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>10. I like playing games that allow me move around during class.</td>
<td>6 (50%)</td>
<td>5 (42%)</td>
<td>0 (0%)</td>
<td>1 (8%)</td>
</tr>
</tbody>
</table>

The results of Part C Survey One as recorded in Table 4.2, showed that nine (75%) of students took part in some form of physical activity during the week with seven (59%) indicating that they were fit. Conversely three (25%) responded that they engaged in little to no physical activity during the week, and five students (41%) believed themselves to be unfit. Over half, seven students (58 %) agreed that they like to be physically active at home, with 10 (84%) agreeing they found it hard to sit still in class for longer than ten minutes. However, 67% or eight students answered that in their spare time at home they spend most of their time watching television or in front of the computer or reading.

In Survey One, five students (41%) indicated that they liked mathematics with seven (69%) students disagreeing with that statement. Although eight students (67%) disagreed with the statement that they find it easy to focus and learn during mathematics lessons, 67% agreed that they currently find mathematics easy to understand when their teacher shows them how
to do something new. In addition, over half, seven students (59%) agreed that they believed that they received good marks in mathematics with the exception of one student agreeing that they liked playing games that allowed them to move around the room during class.

4.2 Cycle One:

4.2.1 Planning and Action:

During Weeks One and Two, 20 minutes of aerobic exercise was introduced to the Year 8 class, three mornings per week before the 45-minute mathematics lessons. Students were encouraged to increase their heart rates to 150 beats per minute and maintain this for the 20 minutes. Each student was given a Fitbit to measure their heart rate. The exercise began with running laps to increase heart rates. The students then chose between three-a-side soccer, or two-a-side basketball. Immediately after exercising they returned to class and participated in the mathematics lesson which focused on algebra.

4.2.2 Observations

4.2.2.1 Teacher/Researcher General Observations:

The process of moving out to the yard to exercise took longer than desired. Initially negative behaviours on leaving the classroom increased. Explicit instruction on how to exit the classroom and move to the yard was required, this was time consuming. There was potential for the ‘stronger’ students to bully the ‘weaker’ students. Initially, the students who were prone to bully chose soccer and the others chose basketball, this delineation proved beneficial. The students who had previously indicated that they did not participate in physical activity were generally resistant to moving and increasing their heart rates. The use of Fitbits was particularly helpful for these students, it allowed them to connect with their bodies and created
a greater awareness of what they were attempting to achieve. On average the sessions of increased heart rate occurred for 10 to 15 minutes, not the full 20 minutes as planned. It was also noted that the students who had chosen soccer began to lose interest, this resulted in a drop in their heart rates. On returning to class the majority of the students focused individually, working at their own pace. The classroom was noticeably quieter than in previous mathematics lessons.

However, during Week Two, negative student behaviours increased in going to and from the exercise area. Some students were also beginning to have issues with the Fitbits, focusing on their heart rate to the detriment of the activity at hand.

4.2.2.2 Teacher Observation

The teacher/researcher also made some specific observations of the whole class during the mathematics lesson using the Teacher Observation (Appendix 1). Although the researcher/teacher paid particular attention to a subsample of four students, she also made observations on the entire class, they are summarised below.

Posture:

The majority of the class sat with good working posture. Two students had to be reminded to sit in a manner conducive to work output.

Academic Progress:

The majority of the students appeared to understand the mathematics lessons. Indications of this included students answering questions posed by the teacher that checked student understanding. The teacher also moved around and checked with individual students with the majority of students demonstrating a sound understanding of the concepts being taught.
Focus:
Students appeared better able to focus during the mathematics lesson that followed the exercise. The class was very quiet; the majority of students began work almost immediately as they re-entered the classroom. The exception was one boy who was attempting to engage with his peers.

Engagement:
The students demonstrated engagement in the mathematics lessons by listening as the teacher presented the lesson and answering questions. All students apart from one settled well to complete the set tasks individually.

Student Behaviours:
The majority of students, ten, engaged in positive behaviours upon re-entering the classroom. As such they sat at their desks, engaged with the lesson being taught and any discussions they had were task related. Two boys, were unsettled by moving outside and joining in the physical activity. One of these students continued to attempt to talk with his peers and gain their attention during the mathematics lesson. The others did not engage with him.

Level of Independence:
At the close of cycle all students were working individually on their set tasks. A small minority of the students were still asking questions like, “Do I open my book now?” However, there had been a noticeable reduction in the students needing to seek guidance on every aspect of their learning.
4.2.2.3 End of Cycle One Student Survey

At the end of the Cycle One, Survey Two (Appendix 2b) was conducted with the class. Two students were absent when this was conducted so only ten students completed this survey.

Although the number of students was less in the second survey a comparison between the two surveys was considered helpful as outlined below.

The results of this survey are presented in the following table

<table>
<thead>
<tr>
<th></th>
<th>Strongly agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I like maths</td>
<td>1 (10%)</td>
<td>5 (50%)</td>
<td>3 (30%)</td>
<td>1 (10%)</td>
</tr>
<tr>
<td>2. I find maths easy to understand when my teacher shows me something new</td>
<td>2 (20%)</td>
<td>7 (70%)</td>
<td>1 (10%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>3. I find it easy to focus and learn during maths lessons</td>
<td>0 (0%)</td>
<td>3 (30%)</td>
<td>7 (70%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>4. I find it hard to sit still in class for longer than 10 minutes</td>
<td>1 (10%)</td>
<td>4 (40%)</td>
<td>4 (40%)</td>
<td>1 (10%)</td>
</tr>
<tr>
<td>5. I get good marks in maths</td>
<td>1 (10%)</td>
<td>7 (70%)</td>
<td>2 (20%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>6. During the aerobic exercise I participated to the best of my ability, trying to raise my heart rate and maintain it.</td>
<td>2 (20%)</td>
<td>8 (80%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>7. I found it easier to concentrate on maths after the aerobic exercise.</td>
<td>2 (20%)</td>
<td>8 (80%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
</tbody>
</table>

At the close of Cycle One the survey showed that six (60%) of the students agreed that they like mathematics, compared with five in Survey One. In addition, the survey showed that eight (80%) students agreed that they find mathematics easy to understand when their teacher shows them something new. This was the same number of students in Survey One. Further, eight (80%) of the students agreed they believed they got good marks in mathematics, compared with seven on Survey One.

At the end of Cycle One five (50%) students agreed that it was hard to sit still for longer than 10 minutes compared with ten (of students in Survey One). In addition, at the end of the
Cycle One survey all ten students agreed they were finding it easier to focus and learn during mathematics after participating in aerobic exercise.

4.2.2.4 Student Interviews

Four students agreed to be interviewed individually. These students were coded as M1, M2, M3, F1 (M=male and F= female). The interview involved five open-ended questions (see Appendix 3a).

In response to the first question, what aspects of mathematics did they find most challenging M1 said that he struggled with division, as well as eight and nine times tables. M2 responded that his challenge came with multiplication and division, M3 was challenged by learning concepts that he does not understand, and F1’s greatest challenge derived from having to transfer a newly learnt concept to another problem.

All four students were able to identify for themselves how they learn mathematics most effectively in response to question two. Three (M1, F1, M3) of the four indicated that they learnt best by watching someone else who knows what they are doing show them. The fourth (M2) learnt best by learning from his mistakes and applying the correction process to further problem.

In response to question three, three (M1, F1, M2) of the students indicated that they struggled with distractions from their peers during lessons. This included both interacting with their friends, socializing, as well as finding noises from their classmates difficult to work with. M1 described it as “Talking with people across the room “. M3 lost focus due to daydreaming.

Three (M1, F1, M2) of the four students indicated in answer to question four, that they found it easier to concentrate in mathematics after participating in exercise. M1 said, “Yes, it made it so that I don’t talk so much.” M2 responded that it made him less likely to talk to others
around him, M3 was not sure that the aerobic exercise had made a difference. He conceded that it may have but he just could not tell.

In response to question five, all four students would include aerobic exercise as part of the school day if they were in charge of the timetable. M1 wanted to include it after every break, M2 and F1 wanted to have it remain at the beginning of the day, while M3 “would put exercise in the middle session (straight after recess) at the start.”

4.2.3 Reflections on Cycle One

As a result of the student behaviours the teacher/researcher decided that the students required more explicit teaching on the elements of exiting and re-entering the classroom in an orderly manner and how to engage in the activities in a positive manner. Thus, the teacher/researcher decided to explicitly teach the required behaviours before starting Cycle Two.

In addition, as the students had lost focus with the soccer game and heart rates reduced the teacher/researcher decided to make an adjustment, for Cycle Two. This adjustment was to combine all students together for one game of basketball, this decision had been made after a particular student was suspended for bullying behaviour. This particular student was present for Cycle One and absent for Cycle Two. The teacher/researcher believed that the bullying issues would be resolved as a result of this one student having been removed.

The exercise routine three times a week before the mathematics lessons appeared to be having a positive effect on the students’ engagement and focus in mathematics lessons and the teacher noted that there was an improvement in their learning outcomes. Thus the teacher/researcher decided to continue with the aerobic routine in Cycle Two and increase it from three mornings to four per week. There was a greater focus on participating in aerobic
exercise for the full 20 minutes in Cycle Two as opposed to the 10 to 15 minutes that took place in Cycle One.

As the students in this special needs school have generally experienced issues in previous school placements, they tend to believe themselves to be poor learners. The teacher/researcher wanted to test to see if the positive affirmations whilst participating in aerobic exercise would be of benefit to the students in improving their confidence in their ability to learn. The students’ generally engaged willingly during the aerobic exercise, it was hoped that this willingness would flow over to the positive affirmations.

4.3 Cycle Two:

4.3.1 Planning and Action:

At the beginning of Cycle Two, the students were introduced to positive affirmations and the power of the mind to affect emotions. The students were presented with the affirmations “I am good at maths” and “I can do this.” The students were encouraged to call out the affirmations during the aerobic exercise. The Year 8 class then participated in 20 minutes of aerobic exercise four mornings per week before the mathematics lessons. Students were encouraged to increase their heart rates to 150 beats per minute and maintain this for the 20 minutes. Students measured their heart rates with the use of Fitbits. As for Cycle One, the exercise began with running laps to increase heart rates. The students then moved to a game of basketball. Immediately after exercising they returned to class and participated in the mathematics lesson. During the first week of Cycle Two mathematics lessons involved revision in what had previously been taught in algebra, and the second week lessons focused on two step equations.
4.3.2 Observations

4.3.2.1 Teacher/ Researcher General Observations

The students were generally more cooperative and enthusiastic about moving out to exercise. They readily used the Fitbits and worked to increase their heart rates. The aerobic exercise which included running the laps and playing basketball lasted for 20 minutes with students increasing their heart rates and maintaining them for this period. The students participated in calling out the positive affirmations of “I am good at maths” and “I can do this,” after running laps and just prior to moving into basketball. As a student threw a basket the ball was held and all the students called out the affirmations together. It was noted that a number of them were reluctant to call the affirmations, they appeared to be self-conscious but half the class, were not concerned and yelled them out with gusto.

There were some changes made to the exercise phase as one male student asked to run laps rather than play basketball. A new female student joined the class during this phase and she had the overall effect of discouraging all the female students to participate in the basketball game. The three female students became focused on socialising with each other, rather than exercising and they walked laps instead of playing basketball. The net effect was a very small rise in heart rate for these students. However, despite this they still believed their participation in this activity assisted them in focusing when in class doing mathematics. On returning to class the students who had participated in exercise appeared invigorated and keen to participate in mathematics.

4.3.2.2 Teacher Observation

Using the same Teacher Observation as for Cycle One (Appendix 1) observations on the class as a whole, during the mathematics lessons are reported below.
Posture:
All students with the exception of one were sitting with a good posture. The one who was sitting with poor posture was the same student from Cycle One.

Academic Progress:
All made good eye contact with the teacher and appeared to follow the flow of the lesson that was being given. Students appeared to consolidate their learning quickly during the revision lessons and were then able to move onto the next level of mathematical task.

Focus and Engagement:
Student focus continued. Indicators included: the class was very quiet; the students began work almost immediately as they re-entered the classroom. Students were engaged at their level. As the skill level of students grew peer tutoring occurred. The overall atmosphere in the classroom was positive even when the students were working on difficult tasks that were stretching them. It was apparent that they wanted to solve the problems on their own rather than be given the answers. This resilience was new.

Student Behaviours:
Negative student behaviours were at a minimum. There was very little, off task talking across the room, as the students were focused on mathematics. The talk that occurred across the room involved students seeking to help and assist each other with mathematics.

Level of Independence:
At the close of the cycle approximately 60% of the students were working independently. As such 40% required assistance. There had been a change in the type
of question that the students were asking, no longer were students asking questions like, “Do I open my book now?”, “Do I use pen or pencil now?”. The students were more independent.

4.3.2.3 End of Cycle Two Student Survey

At the end of Cycle Two, Survey Three was conducted, (Appendix 2c) it was comprised of ten closed questions, some similar to those in previous surveys. Three students were absent when this was conducted, this included the new female student two other male students. It was noted that one of the male students was absent for both Survey Two and Three, while two different students were absent either for Survey Two or Survey Three. Ten students completed this survey. The results of this survey are presented in the following table.

Table 4-4 Results of Survey Three- End of Cycle Two

<table>
<thead>
<tr>
<th></th>
<th>Strongly agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I like maths.</td>
<td>3 (30%)</td>
<td>5 (50%)</td>
<td>1 (10%)</td>
<td>1 (10%)</td>
</tr>
<tr>
<td>2. I find maths easy to understand when my teacher shows me something new.</td>
<td>4 (40%)</td>
<td>6 (60%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>3. I find it easy to focus and learn during maths lessons.</td>
<td>1 (10%)</td>
<td>6 (60%)</td>
<td>3 (30%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>4. I find it hard to sit still in class for longer than 10 minutes.</td>
<td>1 (10%)</td>
<td>3 (30%)</td>
<td>4 (40%)</td>
<td>2 (20%)</td>
</tr>
<tr>
<td>5. I get good marks in maths.</td>
<td>3 (30%)</td>
<td>6 (60%)</td>
<td>1 (10%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>6. During the aerobic exercise I participated to the best of my ability, trying to raise my heart rate and maintain it.</td>
<td>3 (30%)</td>
<td>6 (60%)</td>
<td>1 (10%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>7. I participated fully in the positive affirmations.</td>
<td>2 (20%)</td>
<td>6 (60%)</td>
<td>2 (20%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>8. The positive affirmations helped me feel like I can actually achieve in maths.</td>
<td>1 (10%)</td>
<td>5 (50%)</td>
<td>3 (30%)</td>
<td>1 (10%)</td>
</tr>
<tr>
<td>9. I found it easier to concentrate on maths after the aerobic exercise with positive affirmations.</td>
<td>4 (40%)</td>
<td>3 (30%)</td>
<td>3 (30%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>10. I like maths and think I am able to do it.</td>
<td>4 (40%)</td>
<td>5 (50%)</td>
<td>0 (0%)</td>
<td>1 (10%)</td>
</tr>
</tbody>
</table>
At the close of Cycle Two, Survey Three showed that eight (80%) of the students responded that they like mathematics, compared with six in the previous Survey. All ten students compared with eight in the previous survey agreed that they find mathematics easy to understand when their teacher shows them something new.

Nine students believed that they received good marks in mathematics compared with eight students after Cycle One. Additionally, now only four students had difficulty sitting still for longer than ten minutes compared with ten in Survey One, prior to the exercise and five in the Survey Two after Cycle One. Seven students indicated that they found it easy to focus and learn during mathematics, compared with four in Survey One, and three in Survey Two at the end of Cycle One.

4.2.3.4 Student Interviews

The same four students who had been interviewed at the end of Cycle One were interviewed again at the end of Cycle Two, answering five questions similar to those at the end of Cycle One (see Appendix 3b). These students were coded as M1, M2, M3, F1 (M=male and F=female).

In response to the first question, what aspects did they find most challenging the students responded with similar answers as they had in the Initial Interview. The second question asked students to indicate how they learnt mathematics most effectively. M1 responded that he learnt by doing it, whereas in Interview One he had said that he learnt by watching and by using formulas. M2 that he learnt by watching, this compared to his first answer of “By doing.” M3 said that he learns by being shown how, this was consistent with his response in the first interview. F1 answered that she learnt most effectively by watching and listening to the teacher, this was consistent with her response in the first Interview. It was not clear why these students changed their responses from Interview One to Interview Two.
In response to the third question M1 said that he did not lose focus, this differed from his response in the first Interview of “Talking with people across the room.” M2 answered that he lost focus when the work became too hard for him to do, this compared with his response of becoming involved with others in the room and socialising in the first Interview. M3’s responses in both interviews were similar saying he would just “zone out”. F1 said that she lost focus when the room was too loud. When this happened she found that her thoughts just went away, which was similar to her response in Interview One.

The fourth question asked the students to reflect on the impact of the aerobic exercise on their ability to focus on mathematics. As in the Interview One three of the four indicated that the aerobic exercise helped them to focus to a greater extent. M3 answered that he found his focus was the same with the aerobic exercise as it was without the aerobic exercise.

The next question asked the students to consider the impact of the positive affirmations on their mind set towards mathematics. Two of the four students M2 and F1, indicated that they found the positive affirmations helpful for their overall approach to mathematics. M2 said that he “felt like an idiot saying them out loud”, but he found them helpful to say quietly to himself. M1 responded that they did not really bother him because he already knew he was good at mathematics, so it really did not matter to him if he said them or not. M3 did not know if they helped or hindered his approach to mathematics.

The final question asked the students to consider if they would include aerobic exercise and or positive affirmations if they were in charge of timetabling. All four students agreed that they would include exercise prior to engaging in school work. This response was consistent with students answers in Interview One. Two of the four M2 and F1, agreed, that they would keep the positive affirmations with the exercise with M2 saying that he would include the positive affirmations said silently rather than out loud.
4.2.4 Reflections on Cycle Two

The students participated in the exercise in a positive manner. The students relied on the Fitbits to monitor their heart rates.

Student attitudes towards the positive affirmations was varied. Approximately half the students appeared self-conscious, as they would call them out, yet their body language and tone indicated a level of discomfort. The other half of the class were keen to call out the positive affirmations. On returning to class the affirmations were continued when a mathematical task became difficult. This appeared to assist students with regard to resilience to problem solving. This was demonstrated through greater perseverance and ability to maintain focus during a challenging task.

Mathematics lessons immediately after exercise with positive affirmations were a productive time. The students began problem solving with little distraction. The students were able to sit and concentrate for longer periods than prior to the aerobic exercise with positive affirmations. Their attitudes towards mathematics was positive. The students were keen to peer tutor and assist others in gaining skills, once they had mastered them. They were also keen to participate in the mathematics lesson. There was a noticeable reduction in disruptive student behaviours as the students were busily involved in the task of completing their mathematical problem solving. During Cycle Two more students agreed that they received good marks in mathematics which indicated that their learning outcomes had improved.

4.3 Conclusion

This chapter has outlined the results and analysis of the two cycles of Action Research investigating the effectiveness of movement prior to mathematics classes in improving learning outcomes. The next chapter will discuss the results.
CHAPTER FIVE - DISCUSSION

5.1 Introduction

This chapter discusses the results recorded in Chapter Four with reference to the relevant literature and in answer to the research question: “How effective is using movement prior to mathematics lessons, with Year 8, special needs students in improving learning outcomes through developing greater independence; improved focus and engagement in the lesson?”

The discussion will follow a similar pattern to the Results Chapter by discussing the results related to each of the two Cycles of research.

5.2 Cycle One

Prior to beginning the exercise, the students completed Survey One. This survey indicated that half of the class did not participate in physical activity outside of school hours and could be considered sedentary. It further revealed that the physical fitness of many of the students was low with only half of the students engaged in some form of exercise and 41% considered themselves to be unfit.

In relation to students’ perceptions of mathematics, Survey Two, conducted at the end of Cycle One, after they had participated in aerobic exercise prior to the mathematics lessons, showed a slight increase in the number of students agreeing that they like mathematics; that they find mathematics easy to understand when their teacher shows them something new; and that they believed they got good marks in mathematics. Although this research did not involve testing the students’ knowledge, it was apparent that most of the students believed that they were better understanding the concepts that they were taught. This was consistent with the teacher/researcher’s observation that consolidation of mathematical tasks required
less time for the students to master. Thus indicating an improvement in students’ learning outcomes in mathematics as a result of the aerobic exercise. Although the students in this study were not classified as obese the findings relate to research by Davis (2011) from the USA, who found that obese, sedentary students who participated in aerobic exercise for 40 minutes per day, on school days, performed better in mathematics tests than their peers who were involved in either no aerobic exercise or 20 minutes of exercise per day.

At the end of Cycle One, more students (five out of 10) were finding it easier to sit for longer than 10 minutes compared with 10 out of 12 students in Survey One. All 10 students who completed Survey Two indicated they found it easier to focus and learn mathematics after participating in aerobic exercise compared with only four on Survey One. Three of those interviewed commented that they found it easier to concentrate in mathematics after participating in exercise with M1 saying “Yes, it made it so that I don’t talk so much.”

These findings of greater focus are consistent with the findings of Dwyer, et. al (2001) and Ratey (2008). Dwyer (2001) found that an increase in aerobic exercise was positively correlated to academic performance, further that aerobic exercise before academic work had a calming effect allowing students to focus and concentrate more easily (Dwyer, et.al, 2001, p 236). Ratey holds that exercise is important for activating the brain and for producing a substance that he referred to as “miracle grow” for the brain. Ratey’s research showed that students who were involved in daily exercise, increasing their heart rates to 80% of capacity for 45 minutes, became much more focused and were able to achieve better scores where previously they had struggled. A further study by by Ellemberg and St-Louis-Desêhenes (2010), who investigated the effects of 30 minutes of aerobic exercise compared to 30 minutes of watching television on the cognitive ability of the students. Those who participated in the aerobic exercise significantly out performed those who watched television
(Kohl & Cook, 2013). Thus there appears to be a positive link between aerobic exercise and cognitive ability. This highlights the importance of participating in aerobic exercise at school as 67% of students responded to Survey One that in their spare time at home they spend it watching television or in front of a computer screen.

The students who had indicated that they did not participate in physical activity outside of school, were observed by the teacher/researcher to be generally resistant to moving and increasing their heart rates. The use of Fitbits was particularly helpful for these students as they allowed them to connect with their bodies and created a greater awareness of what they were attempting to achieve. Using the Fitbits is an example of technology improving data gathering as in Dwyer’s study in 1984, when the use of a stethoscope and stop watch was used to gather accurate data on heart rates (Dwyer, et al., 2001, pp 227, 228). The anecdotal evidence from the Naperville school that Ratey (2008) investigated showed students using heart rate monitors with the teacher downloading the data from the monitors.

During the second week in Cycle One the teacher/researcher observed negative student behaviours increasing in going to and from the exercise area. Some students were also beginning to have issues with the Fitbits, focusing on their heart rate to the detriment of the activity at hand.

There was potential for the ‘stronger’ students to bully the ‘weaker’ students and those who were prone to bully chose soccer and the others chose basketball. This delineation proved beneficial and both groups then joined in their respective activities during Cycle One. This reduction in the contact between the aggressor and the victim, which reduces the effects of the audience for the bully is outlined in the Olweus Bullying Prevention Program (OBPP), introduced by the Norwegian government in 1983. The aim of the program was to reduce
bullying behaviours within the school system. *The International Handbook of School Bullying* (Jimerson, Swearer & Espelage, 2010) includes this information.

The students’ behaviour in the mathematics classroom following the aerobic exercise showed an overall improvement in focus and engagement, academic progress, levels of independence, posture and student behaviours. In particular, on returning to class, the teacher/researcher observed that the majority of the students focused individually, working at their own pace. The classroom was noticeably quieter than in previous mathematics lessons. In addition, the majority of the class were sitting with good working posture. Mahar et al., (2006) also found that student attention improved after a session of physical activity, with increased time spent on academic learning, together with a reduction in negative behaviours. Further research, compared traditionally taught lessons with physically active lessons. It was observed that all students, increased time on task immediately after engaging in an active task (Grieco, Jowers & Bartholemew, 2009).

Although, the findings of a literature review by Janssen, Mechelen, Toussaint, & Verhagen (2014) relating to student attention and acute bouts of physical activity within the educational setting were inconclusive, with evidence to both support and refute the overall effects of physical activity on student attention, the current study showed a positive effect of physical activity on student attention. The teacher/researcher observed that the majority of the students appeared to follow the mathematics lessons better after the exercise, for example students answered questions correctly that were posed by the teacher to check student understanding. The majority of students demonstrated sound understanding of the concepts being taught and completed the set tasks individually.

At the end of Cycle One, the exercise routine three times a week before the mathematics lessons appeared to be having a positive effect on the results of the students’ engagement
and focus in mathematics lessons. In addition, the students who were interviewed all stated they would include aerobic exercise as part of the school day if they were in charge of the timetable. Thus the teacher/researcher decided to continue with the aerobic exercise in Cycle Two and encourage the students to participate for the full 20 minutes, as well as increase from three mornings to four per week. The teacher/researcher also planned to introduce positive affirmations in Cycle Two to encourage students in their ability to be successful in mathematics and thus improve their learning outcomes.

5.3 Cycle Two

At the close of Cycle Two, the responses to Survey Three showed that there was an improvement in the number of students who like mathematics, eight out of ten, compared with five students in Survey One and six in Survey Two. A further improvement was demonstrated with all ten surveyed agreeing that they find mathematics easy to understand when their teacher shows them something new. This compared with eight students from Survey One and nine from Survey Two.

Answers to the other questions also showed an improvement at the end of Cycle Two compared with the end of Cycle One, with nine of the ten students believing that they received good marks in mathematics; only four students still had difficulty sitting still for longer than ten minutes and seven out of ten students indicated that they found it easy to focus and learn during mathematics. Thus indicating a positive relationship between aerobic exercise and cognitive ability which was also demonstrated in research conducted by Suzuki (2015) over a Semester at a University.
The positive affirmations combined with the aerobic exercise appeared to also be having a positive effect with six students believing they helped them achieve in mathematics and seven finding it easier to concentrate on mathematics. Two of the four students interviewed indicated that they found the positive affirmations helpful for their overall approach to mathematics although one student said that he “felt like an idiot saying them out loud”, but he found them helpful to say quietly to himself. The study by Suzuki (2015) with her university students who participated in an acute bout of aerobic exercise with positive affirmations called out during the exercise, prior to their lecture showed similar findings to those in this study. At the close of Suzuki’s study, it was concluded that levels of participation in discussion had increased. Assessments on working memory showed a growth in retention.

Other studies on self-talk and academic performance such as that performed by Bernard (2011) reveal a positive correlation between encouraging and goal orientated self-talk and academic performance. The results showed the students who had more positive self-talk achieved more readily at their goals.

Immediately after exercising with the positive affirmations the students engaged in the mathematics lessons. Student engagement, focus, positive behaviours and level of independence continued in a productive manner.

The students continued to make good eye contact with the teacher and appeared to follow the flow of the lesson that was being given. Students consolidated their learning quickly during the revision lessons and were then able to move onto the next level of mathematical task. Student focus continued: the class was very quiet; the students began work almost immediately as they re-entered the classroom. Students were engaged at their level. As the skill level of students grew peer tutoring occurred. The overall atmosphere in the classroom was positive even when the students were working on difficult tasks that were stretching
them. The teacher/researcher noted that levels of independence had steadily increased from Cycle One to Cycle Two. The students were now better able to answer simple questions for themselves, for example “Do I open my book now? Do I use pen or pencil?” It was apparent that they wanted to solve the problems on their own rather than be given the answers. This resilience was new and it appeared that the benefit of positive affirmations said during the 20 minutes of aerobic exercise were effective in improving students’ learning outcomes. Other studies have shown the benefit of positive affirmations said during aerobic exercise such as the research of Ashman, Lee, Shang & Suzuki (2014) who worked with patients who had suffered brain injury as a result of a stroke and demonstrated a positive improvement in the health of their patients. In addition, Bandura (1993) found that a high level of self-belief related positively to individuals achieving goals.

Negative student behaviours were at a minimum during Cycle Two. There was very little, off task talking across the room, as the students were focused on mathematics. The talk that occurred across the room involved students seeking to help and assist each other with mathematics. This improvement in students being willing and wanting to help each other is similar to the findings of a program called “Fit Lit” in the USA, where students participate in 45-minute aerobic exercise prior to English language classes (Edutopia, 2015). The teachers found that the students were able to focus better in English. They also discovered that the students were nicer to each other and wanted to help each other out. They suspected that this came from the fact that the students were assisting each other during the aerobic sessions as they worked in team and this then flowed into the classroom. This would be consistent with the results in this study, the students worked in teams playing basketball, then actively chose to assist one another during class time.
At the end of Cycle Two the students were applying themselves to mathematical problems in a more tenacious way. They were also more willing to take risks and try to problem solve in a way that they had not previously. Additionally, the classroom environment was more settled and conducive to learning. Thus, it appeared that using movement prior to mathematics lessons, with Year 8 special needs students, was effective in improving learning outcomes through development of greater independence; improved focus and engagement in the lesson.

This chapter has discussed the results in relation to the literature. The next chapter will provide the conclusions and recommendations from the study.
CHAPTER SIX – CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

This research study examined “Using movement with Year 8 special needs students to improve students’ learning in mathematics.” It aimed to research the effectiveness of aerobic exercise prior to mathematics lessons in improving student learning outcomes through developing greater independence, improved focus and engagement in the lesson.

The research involved Action Research with two cycles of two weeks each with a Year 8 mathematics class. In Cycle One, the students engaged in 10 to 15 minutes, not the planned 20 minutes, of aerobic exercise three times a week prior to the mathematics lesson. In Cycle Two, students participated in 20 minutes of aerobic exercise with positive affirmations four times a week. Data was analysed from a survey completed by the students prior to the research beginning, then at the conclusion of each cycle; interviews with a subsample of the students at the end of each cycle; and teacher observations during each cycle. The data was analysed in relation to improvement in student engagement, focus and level of independence.

Over the course of this study, changes in student focus, engagement, posture, behaviour and level of independence were observed. The students’ responses on the surveys showed overall an improvement in their response to mathematics, their ability to focus and engage during mathematics lessons, and their overall resilience to problem solving during mathematics indicating an improvement in learning outcomes. These improvements in engagement, focus and independence as a result of the aerobic exercise are consistent with the findings of Dwyer (2001), Ratey & Haggerman (2008) and Suzuki & Fitzpatrick (2015).
As the cycles progressed, the results from the surveys demonstrated a more positive mindset and greater level of engagement in mathematics lessons, with an overall reduction in off task and negative students’ behaviours. It would appear from the results of this study, that student learning outcomes improved because of increased focus, engagement and level of independence as a result of the students participating in 20 minutes of aerobic exercise. Further, it would further appear, that when the students’ participated in 20 minutes of aerobic exercise combined with positive affirmations in Cycle Two that learning outcomes improved further. Hence, overall student resilience increased and the students were more engaged in the mathematics lessons with greater focus and independence.

6.2 Limitations

The Action Research study has several limitations. Firstly, in relation to bias. Bell & Waters (2014) discuss the issue of bias when collecting data, they further highlight that bias can occur in interview with a power imbalance and when there is only one researcher on the study. As the researcher was the class teacher for this group of Year 8 students and completed the research on her own, this could limit the impartiality of the results. Further, as this study was completed by the researcher within her own classroom context, this is not necessarily generalizable to other classroom contexts. Bell & Waters (2014) examine the issue of generalisation of results based on insufficient data. They cite Bassey (1981: 85) who discusses the importance of the data produced from research to be reliable rather than generalizable (Bassey cited in Bell & Waters, 2014). Therefore, a limitation of this study is that the results relate for this Year 8, special needs class, but may not relate to another class.
As this study was conducted in a special needs school, there are a number of students who struggle with attendance. This created issues in relation to data collection and full participation in the research program. There were also issues in relation to the amount of exercise that could be introduced into the program. Twenty minutes of exercise four times per week required 120 minutes or two hours per week. This time was taken from the Personal Development, Health and Physical Education component of the school timetable. There was no extra time to allocate to exercise, limiting the results obtained.

6.3 Recommendations for Further Study

Recommendations from this study involve greater exploration of the role of positive affirmations and how to embed them further in the classroom context. A third cycle could have focused on the students setting their own goals and developing personal affirmation statements that they could say either quietly to themselves or out loud during aerobic exercise. At the close of a third cycle the students could be given the opportunity to reflect on how their mindset and attitudes had changed as a result of making and practicing the positive affirmations.

In addition, this study could be extended to students who are in other classes including their final year of school. Encouraging students to participate in exercise before class or as final year students may enable students to more readily set goals and achieve them as they look towards a future beyond the school setting.
6.4 Conclusion

This Action Research study has shown the effectiveness of regular aerobic exercise combined with positive affirmations held before a mathematics class in improving student learning outcomes through increased student focus, engagement, and levels of independence. The findings showed an improvement notably, in student belief in their own ability within the subject area of mathematics. This combined with greater levels of student engagement and focus with noticeably fewer off task and negative student behaviours resulted in improved learning outcomes. Thus, the results of the study show that participation in aerobic exercise, is effective in improving learning outcomes in mathematics.
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## Appendix 1: Teacher Observations

<table>
<thead>
<tr>
<th>Student:</th>
<th>Cycle:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnosis:</td>
<td></td>
</tr>
<tr>
<td>Gender:</td>
<td></td>
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<tr>
<td>Focus:</td>
<td></td>
</tr>
<tr>
<td>Posture:</td>
<td></td>
</tr>
<tr>
<td>Academic Progress:</td>
<td></td>
</tr>
<tr>
<td>Student Behaviours:</td>
<td></td>
</tr>
<tr>
<td>Level of independence:</td>
<td></td>
</tr>
</tbody>
</table>
Appendix 2a: Survey One: Year 8 students, exercise and mathematics

Name: ________________________________ Date: __________________

1. How many minutes of walking do you estimate you do per day on average? (circle the answer that best describes you)
   Over 60 minutes; 50 – 40 minutes: 40 – 30 minutes; 30 – 20 minutes? Less than 20 minutes

2. What other types of exercise do you do? (Tick the ones that apply)
   Swimming
   Dancing
   Aerobics
   Soccer
   Football
   Running
   Netball
   Basketball
   Other (list any other types of exercise you do) _______________________

| 1. I take part in some form of physical exercise out of school at least twice a week | Strongly agree | Agree | Disagree | Strongly disagree |
| 2. I am fit | | | | |
| 3. In my spare time at home I like to be physically active: | | | | |
| 4. I find it hard to sit still in class for longer than 10 minutes | | | | |
| 5. In my spare time at home I spend most of my time watching TV or in front of the computer or reading? | | | | |
| 6. I like maths | | | | |
| 7. I find maths easy to understand when my teacher shows me something new | | | | |
| 8. I find it easy to focus and learn during maths lessons | | | | |
| 9. I get good marks in maths | | | | |
| 10. I like playing games that allow me move around during class. | | | | |
Appendix 2b: Survey 2: After cycle one, with the introduction of aerobic exercise

Name: ____________________________________ Date: __________________ 

<table>
<thead>
<tr>
<th></th>
<th>Strongly agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I like maths</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. I find maths easy to understand when my teacher shows me something new</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. I find it easy to focus and learn during maths lessons</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. I find it hard to sit still in class for longer than 10 minutes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. I get good marks in maths</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. During the aerobic exercise I participated to the best of my ability, trying to raise my heart rate and maintain it.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. I found it easier to concentrate on maths after the aerobic exercise.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix 2c: Survey 3: After cycle two, with the introduction of aerobic exercise with positive affirmations

<table>
<thead>
<tr>
<th></th>
<th>Strongly agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>I like maths.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>I find maths easy to understand when my teacher shows me something new.</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>3.</td>
<td>I find it easy to focus and learn during maths lessons.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>I find it hard to sit still in class for longer than 10 minutes.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>I get good marks in maths.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>During the aerobic exercise I participated to the best of my ability, trying to raise my heart rate and maintain it.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>I participated fully in the positive affirmations.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>The positive affirmations helped me feel like I can actually achieve in maths.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>I found it easier to concentrate on maths after the aerobic exercise with positive affirmations.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>I like maths and think I am able to do it.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Name: ____________________________ Date: __________________
Appendix 3a: Interview One

Interview Questions with Year 8 students Related to Exercise and Mathematics,

After cycle one, the introduction of aerobic exercise

Background information:

Gender: ____________________
Age: _______________________
Diagnosis: ____________________

Questions:

1. What aspects of mathematics do you find most challenging?__________________________
   ______________________________________________________________________________
   ______________________________________________________________________________

2. How do you learn mathematics the most effectively? By doing? Watching? Using concrete
   materials? ___________________________ _________________________
   ______________________________________________________________________________
   ______________________________________________________________________________

3. If you struggle to focus during mathematics, can you name for me what occurs for you when
   you lose focus? _______________________________________________
   ______________________________________________________________________________
   ______________________________________________________________________________
   ______________________________________________________________________________

4. Did you notice a difference in your ability to focus in mathematics after participating in the
   aerobic exercise? Can you describe that for me? __________________________
   ______________________________________________________________________________

5. If you were given the opportunity to design the education program here what would it look
   like? Would you include exercise? Explain your answer
   ______________________________________________________________________________
   ______________________________________________________________________________
   ______________________________________________________________________________
<table>
<thead>
<tr>
<th></th>
<th>Student M1</th>
<th>Student F1</th>
<th>Student M2</th>
<th>Student M3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What aspects of mathematics do you find most challenging?</td>
<td>Division, as well as 8 and 9 times tables.</td>
<td>Learning new things, and transferring a new skill to something else.</td>
<td>Ones that you have to times numbers or divide them and get the answer</td>
<td>When I learn something I don’t understand.</td>
</tr>
<tr>
<td>2. How do you learn mathematics the most effectively? By doing? Watching? Using concrete materials?</td>
<td>By using formulas and by watching</td>
<td>Watching how its done, then doing it myself.</td>
<td>By doing so I know what I’m doing and if I make a mistake I know where I went wrong.</td>
<td>I learnt by using my fingers and by being shown</td>
</tr>
<tr>
<td>3. If you struggle to focus during mathematics, can you name for me what occurs for you when you lose focus?</td>
<td>Talking with people across the room</td>
<td>Loud noises make it difficult for me to remember what I’m doing</td>
<td>Looking across the room at people and sometimes its hard (to stay focused when I do this)</td>
<td>I day dream about nothing</td>
</tr>
<tr>
<td>4. Did you notice a difference in your ability to focus in mathematics after participating in the aerobic exercise? Can you describe that for me?</td>
<td>Yes it made it so that I don’t talk so much</td>
<td>Yes it was easier to concentrate and stay on task.</td>
<td>I found it easier to focus and I can get my work done (after exercise)</td>
<td>No, well there might have been a little difference but I didn’t notice it.</td>
</tr>
<tr>
<td>5. If you were given the opportunity to design the education program here what would it look like? Would you include exercise? Explain your answer</td>
<td>Everyday I would be replacing quiet reading with exercise for 10 minutes so that the effects are stronger.</td>
<td>Yes I would put exercise before maths like we did.</td>
<td>I would do exercise before maths in the first session.</td>
<td>Yes I would put exercise in the middle session (straight after recess) at the start.</td>
</tr>
</tbody>
</table>
Appendix 3b: Interview Two

Interview Questions with Year 8 students Related to Exercise and Mathematics,

After cycle two, the introduction of aerobic exercise with positive affirmations

Background information:

Gender: ____________________
Age: ____________________
Diagnosis: ____________________

Questions:

1. What aspects of mathematics do you find most challenging? ____________________

   __________________________________________________________
   __________________________________________________________


   __________________________________________________________
   __________________________________________________________

3. If you struggle to focus during mathematics, can you name for me what occurs for you when you lose focus? ____________________

   __________________________________________________________
   __________________________________________________________

4. Did you notice a difference in your ability to focus in mathematics after participating in the aerobic exercise? Can you describe that for me? ____________________

   __________________________________________________________

5. What effect did the positive affirmations have on your mind set when you approached mathematics? ____________________

   __________________________________________________________
   __________________________________________________________

6. If you were given the opportunity to design the education program here what would it look like? Would you include exercise? Positive affirmations? Explain your answer

   __________________________________________________________
   __________________________________________________________
   __________________________________________________________
### Appendix 3b: Interview Two: Responses – Cycle Two

<table>
<thead>
<tr>
<th>Question</th>
<th>Student M1</th>
<th>Student F1</th>
<th>Student M2</th>
<th>Student M3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What aspects of mathematics do you find most challenging?</td>
<td>Division</td>
<td>A new concept</td>
<td>All the calculations and stuff</td>
<td>When I first learn something and you don’t show me how its done</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fractions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. How do you learn mathematics the most effectively? By doing? Watching? Using concrete materials?</td>
<td>By doing it</td>
<td>Watching the teacher and listening</td>
<td>By watching</td>
<td>When someone shows me how</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. If you struggle to focus during mathematics, can you name for me what occurs for you when you lose focus?</td>
<td>I don’t lose focus</td>
<td>When there are loud noises, my thoughts go away</td>
<td>I lose focus when it gets too hard</td>
<td>I just zone out</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>4. Did you notice a difference in your ability to focus in mathematics after participating in the aerobic exercise? Can you describe that for me?</td>
<td>Yes I was less heightened</td>
<td>Yeah a little bit. I felt more focused and got my energy out</td>
<td>I was able to concentrate better after the exercise</td>
<td>I found it the same</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>5. What effect did the positive affirmations have on your mind set when you approached mathematics?</td>
<td>Nothing really because I already knew I was good at maths, so it didn’t bother me</td>
<td>It was helpful</td>
<td>It was kinda good, I felt like an idiot, I did say it to myself quietly</td>
<td>I don’t know</td>
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</tr>
<tr>
<td>6. If you were given the opportunity to design the education program here what would it look like? Would you include exercise? Positive affirmations? Explain your answer</td>
<td>Exercise before maths and after each session because that’s when we’re heightened</td>
<td>Exercise before maths, with the positive affirmations</td>
<td>The exercise was helpful, and I would do this before work. The affirmations were good, but I felt like a wally, if we could do them silently it would be good</td>
<td>I would keep the exercise because we were more settled I think</td>
</tr>
</tbody>
</table>